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PRESERVING COMMUNICATION CONTEXT

Virtual workspace and interpersonal space in Japanese CSCW

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Abstract. The past decade has seen the development of a perspective holding that technology is socially constructed (Mackenzie and Wacjman, 1985; Bijker, Hughes and Pinch, 1987; Bijker and Law, 1992). This paper examines the social construction of one group of technologies, systems for computer supported cooperative work (CSCW). It describes the design of CSCW in Japan, with particular attention to the influence of culture on the design process. Two case studies are presented to illustrate the argument that culture is an important factor in technology design, despite commonly held assumptions about the neutrality and objectivity of science and technology. The paper further argues that, by looking at CSCW systems as texts which reflect the context of their production and the society from which they come, we may be better able to understand the transformations that operate when these texts are "read" in the contexts of their implementation.

This paper describes the design of systems for computer supported cooperative work (CSCW) in Japan with particular attention to the influence of culture. In doing so, it raises larger issues of the relationship between technology and context, asking how ideas and circumstances affect action. As such, it is part of a growing body of work struggling to come to terms with this question, made more significant by increasing globalization and the growing impact of technology (computer-based or not) in our lives.

We believe that CSCW is a particularly appropriate object for this type of inquiry, since it is generally recognized as a field which spans a number of boundaries and integrates a variety of perspectives, ranging from those of hard science (engineering) to social science and even philosophy. As such, it can be thought of as a messy model or hybrid, in which the social and the technical are inextricably intertwined. The social "content" of a CSCW system is thus much greater that that of, say, a toaster or even a television. On the other hand, one

cannot make abstraction of the very real technical knowledge and constraints that go into building a working system.

This paper suggests that CSCW systems, like all technologies, can be read as texts. These technological texts contain some elements which are distinctive to their culture of origin, without necessarily being unique to that context. It further offers a plausible explanation for these design choices, basing its argument in the discourse of designers themselves. It draws on the notion of technological frame (Bijker and Law, 1992) to explain how Japanese CSCW designers invoke Japanese culture in general and certain aspects in particular as resources upon which to found technical decisions, illustrating the translation of these cultural arguments in CSCW systems.[1]

1. Background

Cultural attitudes towards technology and cultural dimensions in the implementation and use of technology are topics of increasing interest worldwide, perhaps as a result of increasing globalization and intercultural contact. This subject is becoming all the more significant with the proliferation of new communications technologies which hold out the promise of global communication. The novelty of new computer-mediated communication networks does not, however, mean that we must start from scratch in attempting to understand how people from different cultures will use them, and how diverse cultural attitudes are likely to affect their use. Over the past twenty years these question have in fact been explored in the fields of both organizational and development communication.

In development communication, a turn-key approach to technology transfer has been rejected in favor of other models which accord substantial importance to culture. Among them, there has been considerable research on the importance of technological infrastructure and predisposition or competency as preconditions for technology transfer (Andrews and Miller, 1987; Copeland, 1986), as well as various measures for increasing the likelihood of successful transfer: modification of imported technology by local engineers to make it more “appropriate” (De Laet, 1994; Ito, 1986), a two-step flow in which new ideas or technology are introduced first to an opinion leader or technological gatekeeper who then persuades others to adopt it (Rogers and Shoemaker, 1971), or involving stakeholders in planning and decisions (Ackoff, 1981; Madu, 1992). All this work shares a concern for facilitating accommodation to a

[1] It is not the intention of this paper to demonstrate causality, and the author is well aware of the dangers involved in the retrospective reconstruction of intentions and influences from a finished product so characteristic of early SCOT (social construction of technology) work. It should simply be read within the larger objective of clarifying the relationship between what designers do and how they do it, and between what they do and what they say.

changing environment produced with the introduction of new technology. In other words, making the technology fit its context of implementation and use has been found to considerably improve the chances of optimal use.

Understanding the reciprocal link between organizational practices and technologies has also been a key concern of organizational communication scholars, particularly with the advent of office automation and computerization. Many have drawn on Giddens" structuration work (Orlikowski and Gash, 1994; Orlikowski, 1992; Poole and DeSanctis, 1990) to explain how computerization changes organizational structure. Heath and Luff (1994) have studied the evolution of social interaction in technological environments. In the field of information systems management, several authors have suggested that differences in national culture may explain differences in IS effects (Deans and Ricks, 1991; Raman and Watson, 1994; Watson and Brancheau, 1991).

In short, studies in development and organizational communication over the past two decades have consistently pointed to three key factors in explaining successful IT implementation:

1. existing technological infrastructure and predisposition - the context;
2. the process of implementation; and
3. the importance of viewing use as a process in which uses change over time. This is evidenced in needs and gratifications, and active reception theories of communication.

At the same time, there has been a growing backlash against technological determinism, an increasing awareness that the path a given technology takes may not be inevitable and absolute. Although many engineers may continue to support the position that the technologies they build are neutral, it has become something of a commonplace in the social sciences to say that technology is socially constructed. In recent years, numerous instances of how technical artifacts embody political, cultural or economic positions have been identified (see for example the collections edited by Bijker, Hughes and Pinch,1987 and Bijker and Law, 1992, as well as Winner, 1993). Increasingly, it appears important to understand how technological artifacts are constructed and how the end result relates to its conditions of construction if we are to understand their implementation and use.

The challenge for social science, in our view, is to go a step further to examine *how* this process of social construction is accomplished and to determine which aspects of the black box called "technology" are more or less susceptible to social influences. By asking how ideas and circumstance affect action, we are in fact raising larger issues of the relationship between technology and context. As such, this research is part of a growing body of work struggling to come to terms with this question of growing significance given increasing globalization and the increasing impact of technology (computer-based or not) in our lives. (Hales, 1994; Jackson, 1996).

2. Research Question and Method

This paper focuses on one object: computer-supported cooperative work (CSCW), one stage in the process: design, and one cultural context: Japan. It is based on a larger, comparative study (Heaton, 1997) whose central research question was the extent to which different preoccupations in different countries are the result of different "cultural constructions of computing." In other words:

1. How do CSCW designers translate their ideas about what people do when they work, and the role of computers in supporting work, into the systems they design?
2. What is the impact of the circumstances[2] in which designers find themselves, on the systems they design?

Given the complexity of the subject matter, and the small number of laboratories actually involved in CSCW design, we adopted a case study approach as an appropriate means of capturing the subtleties of the multitude of situational variables and their interaction. During five months of observation in various CSCW laboratories, the author conducted extensive interviews with over twenty software designers and took part in numerous informal conversations with others involved in CSCW research. Earlier typologies of cultures, particularly as they have been applied to the world of work, were used as a starting point and a general guide for observation, although no attempt was made to fit the data gathered into these classificatory schemes. Analysis of documents produced by the laboratories in question was also an important part of the process. Some of these documents described the CSCW systems, while others were explanatory in nature. Both internal (working documents, memos, project reports) and external documents (scientific publications) were analyzed. The focus was double: to understand how designers perceive their work through what they say and write about it, and to analyze the work itself (both work practices and the resulting machines and software), the goal being to draw parallels between the two.

The present paper focuses primarily on the relationship between designers' justifications for their choices and how these choices are reflected in the design of machines and software. The specific cases presented are illustrative of larger tendencies and trends in CSCW design in Japan.

3. Patterns in CSCW Research

In the context of this paper, CSCW has been broadly defined as: *work by multiple active subjects sharing a common object and supported by information*

[2] Circumstances here include the larger institutional context, as well as daily work practices, which serve as both resources and constraints on what can be *done*. While they provide structure, these resources and constraints should not be taken to be immutable.

technology. The presence of active subjects provides a means for delineating CSCW from traditional office automation perspectives. Furthermore, a community which shares a common object of work can always be delineated in practice, whatever the contributions of the different participants. The focus of computer supported cooperative work, then, is less on working with computers than on working with each other *through* computers. This changing orientation opens the door to a real contribution from social scientists to understanding the complex relationship between technology and its context of emergence and implementation.

A quick survey of the CSCW literature points to an amazing variety of "solutions" or approaches to similar problems. What is more, these solutions seem to follow certain patterns. Not only are there very real differences between the various communities of practice involved in CSCW[3], the field also demonstrates marked regional differences in emphasis and perspective. American CSCW has tended to take an empirical approach and to focus on product development and small-group applications, while Europeans are generally more theoretical or philosophical in orientation and tend to focus on the user organizations and organization systems. In Japan, considerations have generally been pragmatic and there is considerable interest in formal workflow management systems and the software factory concept.

A systematic review of the CSCW and European CSCW conference proceedings over the past decade (Heaton, 1997) documents a number of general patterns in how CSCW researchers present their work to the international academic community of their peers. Presentations coming out of Japan illustrate a considerable homogeneity in research interests. *All* the research presented at international CSCW conferences has centered on the exploration of the possibilities of video, multimedia, and large screen displays. Gesture has a major importance, as does shared view of workspaces. Japanese work tends to present solutions which are technically innovative and which require major investments of technical resources (high bandwidth communication channels, large flat screen displays, a number of video cameras, etc.) Finally, the Japanese groupware scene is much more technically oriented than European or American contexts. Japanese researchers readily admit to their technical focus and product orientation. In fact, one of the prime criteria for evaluating a research project appears to be whether or not it is up and running, and it is inconceivable for the researchers interviewed that research not lead to a *working* system.

In contrast, video-mediated communication is completely absent in Scandinavian work, which focuses on organizational issues and is typically presented in

[3] The pervasive tension between designer/engineers on the one hand and social scientists on the other has been referred to within the CSCW world as the "great divide". It is increasingly recognized as a fact (even a defining characteristic) within the field. (see Bannon and Schmidt, 1991)

the form of cases in which designers have been active participants. Cooperative design, supporting users in their daily work, and looking at work as situated in a specific context are common themes. British work is fairly equally distributed among case studies, conceptual and technical articles, while the volume and variety of work done in North America makes it very difficult to classify: all tendencies are represented, from high-tech video-intensive environments, to ethnographic studies of implementation and use, to theoretical models of coordination.

The question remains: how can we explain that designers, who have similar technical knowledge and professional backgrounds, choose to explore different issues or questions, and, what is more, appear to answer them in different ways? This is all the more astonishing given the fact that they identify themselves as members of the same research community and are in regular contact with designers from various countries and institutions. Clearly differences between communities of practice alone cannot explain these differences in orientation. Grudin (1991a, 1991b) has outlined a number of partial explanations: institutional support, funding, even cultural norms; others have applied an actor-network approach to analyze the political and cultural regimes in which design is embedded in specific cases (Gärtner and Wagner 1994; Hakken, 1994). Here, we seek an explanation for regional differences in CSCW not in institutional variables, nor in strictly professional ones, but at a mid-level between micro and macro - in culture, which is both an individual attribute and a collective phenomenon. Field research provides concrete illustrations of the importance of culture as a variable in the technology design process.

4. On Culture

While Japanese CSCW design is the focus of this paper, this should not be taken to imply simply a discussion of national culture. As will become clear in the discussion of our cases, organizational and professional cultures are also vital elements in the mix. First, however, some background and clarification of what we mean by culture is in order.

The movement to distinguish between national cultures finds its roots in social anthropology of the 1930s and 40s. More recently, forces in the real world have heightened awareness of the importance of the cultural factor and a number of studies on work organization and work attitudes have consistently demonstrated significant differences across national cultures. Among a number of typologies of cultures, the most widely cited and one of the most thorough is that of Geert Hofstede. In an attempt to identify cultural predispositions that

Bourdieu has called *habitus*[4], Hofstede (1980) administered standardized questionnaires to some 116,000 people working for IBM in a variety of professions in over 50 countries in 1968 and again in 1972. On the basis of this data, Hofstede defined several *dimensions of culture*.[5] This, and other similar studies clearly indicate that people from different cultures bring different attitudes to their work and that this results in national differences in the way work is organized as well as in different work practices.

Japan, for example, can be characterized as a group-oriented society with a long-term orientation, strong uncertainty avoidance, highly differentiated gender roles, and which accepts the unequal distribution of power. North American society, on the other hand, is highly individualistic and less tolerant of the unequal distribution of power, with a short-term orientation, and medium degrees of uncertainty avoidance and gender role distinction. The four Scandinavian countries form a relatively homogeneous group, with few gender distinctions and generally low power distance, more group-oriented than North America but less so than Japan.

Another body of literature has examined differences in attitudes, values and practices between professions. A person's occupation or training undoubtedly has a major influence on how he or she approaches the world. For example, computer scientists likely draw on a similar pool of knowledge and techniques relative to systems development, which in turn calls for and constitutes a particular way of looking at the world.[6] Similarly, social scientists may not always share common frames of reference but most will share certain elements of common knowledge. In the case of CSCW, it is probably justifiable to

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[4] Bourdieu's idea is that certain conditions of existence produce a habitus, a system of permanent and transferable dispositions. A habitus functions as the basis for practices and images which can be collectively orchestrated without an actual conductor.

[5] The first dimension, that of *power distance*, refers not the actual distribution of power, but to the extent to which the less powerful members of institutions and organizations within a country expect and accept that power is distributed unequally. This dimension has implications for hierarchy, centralization, privilege and status symbols. The *individualism/collectivism* dimension identifies the strength of ties to and belonging in a group. One might expect this dimension to be correlated with loyalty, trust, shared resources, even the relative importance of verbal or nonverbal communication. The *masculinity/femininity* dimension measures the clarity of gender role distinction, with masculine cultures having clearly defined gender, and feminine cultures considerable overlap. Finally, the *uncertainty avoidance* dimension measures the tolerance (or intolerance) of ambiguity, the way in which people cope with uncertain or unknown situations. In the workplace, one might expect correlations with the way the environment is structured, rules, precision and punctuality, tolerance of new ideas, as well as with motivation (achievement, security, esteem, belonging).

[6] Although the training of computer scientists in Scandinavia, Japan and North America may also differ significantly in terms of "peripheral" components, with consequent implications for how they see their role. See Dahlbom and Mathiassen (1993) for a detailed description of the mechanistic, rational worldviews implicit in computer science and systems development.

distinguish a third general professional group, composed of managers and end-users.

Professional culture becomes a central concern as soon as communication between communities of practice becomes necessary. Systems engineers may be operating from one set of assumptions, while those studying the work practices the system is designed to support or supplant may have a fundamentally different perception of the task at hand, and those who initiated the project (upper management, unions, etc.) yet other objectives and perceptions. The negotiation of shared meanings is a key research issue in CSCW. [7]

Ulf Hannerz (1992: 249) has coined the term transnational cultures, which he defines as "structures of meaning carried by social networks which are not wholly based in any single territory." Many transnational cultures are occupational. Hannerz suggests that, while it makes sense to see them as a particular phenomenon, they must at the same time be seen in their relationships to territorially based cultures and argues that their real significance lies in their mediating possibilities. While "transnational cultures are penetrable to various degrees by the local meanings carried in settings and by participants in particular situations"(p. 251), they also provide points of contact between different territorial cultures.

The important point here is that occupational culture need not be a subset of national culture. Rather, the two are distinct and interrelated. Those involved in CSCW system design share a common "CSCW culture"[8], but they also reflect and interpret this professional culture within the framework of their territorial cultures, just as professional training and perspectives lead them to interpret elements of territorial culture in certain ways. A given situation, say the design of a particular CSCW system, can be understood in cultural terms as the product of what is unique (national culture) and what is shared by all (occupational culture). The resulting combination of the two will necessarily differ between cultures and even between systems in the same national culture, because conditions can never be identical.

Finally, there is organizational culture, which is perhaps best understood as a root metaphor. Starting with the premise that organization rests in shared systems of meaning, and hence in the shared interpretative schemes that create and recreate that meaning, it directs attention to the symbolic or even "magical" significance of even the most rational aspects of organizational life and calls for recognition of the complexity of everyday (organizational) life. Erez and Earley (1993: 69) cite a number of empirical studies which suggest that national or

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[7] The notions of communities of practice, boundary practices and boundary objects have been explored by a number of authors, including Brown and Duguid (1991, 1994), Wenger (1990), Star and Griesemer (1989).

[8] This should not be taken to suggest that there one could identify a single CSCW culture. Far from it! It is surely more appropriate to talk about a *mix* of CSCW influences.

societal culture must be considered along with organizational culture in order to fully understand the relation of an organization's culture to its functioning.

In summary, for the purposes of this research culture is defined as a dynamic mix of national/geographic, organizational, and professional or disciplinary variables in constant interaction with one another. Culture changes according to context and over time, and should be understood not in terms of pre-existing, fixed categories, but as resources, accumulations of actions, patterns which constitute, reinforce and transform social life. In short, culture is continually constructed and reconstructed.

5. Culture in the Frames of CSCW Researchers

The notion of technological frame provides an interesting way of approaching culture from a constructivist perspective. Law and Bijker (1992:301) uses the notion to "refer to the concepts, techniques and resources used in a community - any community. ... It is thus a combination of explicit theory, tacit knowledge, general engineering practice, cultural values, prescribed testing procedures, devices, material networks, and systems used in a community." It is simultaneously technical and social, intrinsically heterogeneous. The related expression *frame of meaning* as coined by Collins and Pinch (1982) and adopted by Carlson (1992) in his study of Edison and the development of motion pictures, translates the specific focus of this paper on how cultural patterns and assumptions inform actions and shape choices most closely:

> ... in any given culture there are many ways in which a technology may be successfully used... To select from among these alternatives, individuals must make assumptions about who will use a technology and the meanings users might assign to it. These assumptions constitute a frame of meaning inventors and entrepreneurs use to guide their efforts at designing, manufacturing, and marketing their technological artifacts. Such frames thus directly link the inventor's unique artifact with larger social or cultural values. (Carlson, 1992:177)

Carlson argues that designers attempt to impose pre-existing frames based on previous experience on new products or invention, rather than inventing new frames. This unconscious process of "cultural creep" results because designers create artifacts to fit into the cultural spaces suggested by their existing frames of meaning. It is only after their introduction that new uses and new cultural meanings are developed. Thus, users are present *virtually* in designers' frames, whether or not an artifact has actually been used (Flichy, 1995). The distinction between design and use thus appears more of an analytic convenience than a hard and fast rule. Consequently, we suggest that it may be more valuable to

approach design-implementation-use as a single process, in which all stages are interrelated.

The following section presents the world of two Japanese CSCW laboratories, with a view to highlighting common research themes. A brief description of the overall context of CSCW design in Japan is followed by detailed presentation of two research projects. The section concludes with a discussion of general trends and characteristics and relates them to cultural characteristics and beliefs, which are intimately connected to designers' views of their systems' eventual use.

6. Japanese CSCW: Quality (and Quantity) of Work

CSCW in Japan is a development of the telecommunications, electronics and engineering industries and is thus closely identified with a product, rather than a research orientation. A "hard" science approach dominates. Virtually all those involved in designing CSCW systems in Japan are engineers or computer scientists. They identify strongly with their profession, and building a *good* system, that is one that works, is reliable, state-of-the art, original, is both the goal and a measure of their capabilities as engineers. Design work is done exclusively in the labs, and any evaluation of prototypes takes the form of controlled laboratory experiments. Designers are not generally concerned with who will use their systems, or how they will be implemented. Multidisciplinary collaboration is not considered, let alone practiced.

With so technical a focus, it is not surprising that the main justifications for design choices are technical ones. There is however, another, more social, element to Japanese design choices, that of Japanese culture. Professional engineering or scientific culture notwithstanding, Japanese CSCW researchers, like most Japanese people, clearly believe that Japanese culture and the Japanese way of working are different from the Western ways.[9] How to reflect or cope with this difference in designing technology is a constant *leitmotif* among Japanese CSCW researchers. Although most would prefer to believe that science and technology are culturally neutral or universal, they nevertheless recognize that, if use is a consideration, designing a groupware system cannot be approached the same way as designing a television.

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[9] Mouer and Sugimoto (1986) trace the long history of the theme of Japanese uniqueness and suggest that, while the ideology of Japanese uniqueness has been used in the service of many interests, the basic assumption that all Japanese possess a common set of attitudes and share similar behavior patterns has remained largely unquestioned, particularly in English language publications. They conclude that the relationship between this ideology and views of Japanese society is maintained by a complex network of interpersonal and inter-institutional relationships. In other words, Japanology is a self-fulfilling prophesy, a social construction almost universally subscribed to.

The dean of groupware in Japan, Professor Matsushita, cites five principal specifically cultural reasons why groupware must be different if it is to be used in Japan: cultural differences in views on cooperation and competition, negotiation style, degree of context, the importance of human relations, and the relation of the individual to the group. Even those who deny specifically cultural aspects in the design of CSCW and groupware in Japan, acknowledge cultural effects in implementation and use. Some major Japanese companies are now selling workflow systems developed by American companies, but this is problematic. In the words of another leading researcher, the biggest challenge facing Japanese groupware is "attaining widespread use. Managers don't want to change the way they work. They want to be able to consult with people as they usually do."

How does this desire to reflect cultural particularities play out in practice?

6.1. TEAMWORKSTATION/CLEARBOARD (NTT HUMAN INTERFACE LABS)

Our first example, TeamWorkStation, is one of the earliest and most documented Japanese CSCW projects. It has been widely cited within the CSCW community and has inspired considerable research within Japan around the concepts of seamlessness and gaze awareness. Ishii and his collaborators at NTT Human Interface Labs were not the first to develop the concept of a seamless work environment, however; nor were they the first to explore peripheral awareness. Both were borrowed from work done originally at Xerox PARC. But the Japanese way of dealing with these issues is unique, and the progression from TeamWorkStation I to TWS II to ClearFace to ClearBoard is illustrative of incremental development of research intuitions as well the resolution of technical problems.

TeamWorkStation (TWS) is "a desktop real-time shared workspace" which integrates both computer and desktop workspaces. Starting from the premise that "no new piece of technology should block the potential use of already existing tools and methods" (Ishii and Miyake, 1991: 39), the team set out to design a system that would allow users to maintain their preferred work practices, using their preferred computer applications, or even working with pencil and paper within a shared virtual workspace. Acknowledging that people might not do everything by computer and supporting their continued use of paper-based media were revolutionary concepts in CSCW at the time.

A second design requirement was a shared drawing surface. The research team chose video as the basic media of TWS for its ability to fuse traditionally incompatible media such as papers and computer files (Ishii and Miyake, 1991: 39). Live video image synthesis was employed to capture individual workspaces (both computer screens and physical desktops) and to display them in separate layers on a computer monitor. The overlay function created with this technique

allowed users to combine individual workspaces, and to point to and draw on the overlaid images simultaneously.

The three-member design team began to use the prototype on a daily basis in July 1989, and informal evaluations of its use pointed to the importance of gesture as a means of enforcing the sense of shared space. They preferred hand gestures to pointing or marking with a mouse "because hand gestures are much more expressive, and because hand marking is generally quicker" (Ishii and Miyake, 1991: 45). Since the TWS prototype was designed without a formal floor control mechanism for passing the input control among collaborators, voice contact played an important role in preserving informal social protocol and coordinating action, especially the use of the limited workspace on the shared screen (Ishii and Miyake, 1991: 45).

The faces of collaborators were displayed in separate windows beside the shared workspace in TWS. But spatial awareness was already a concern, and was developed further by ClearFace and later ClearBoard. All previous approaches to CSCW screen layout (tiling (i.e. laying them side by side) or overlapping windows) required users to shift their focus between the shared drawing space and the facial images and deal with separately. Developed initially as a solution to a technical problem: how to make the most of limited screen size (14" in the TWS prototype), the ClearFace interface proposed translucent, movable and resizable face windows which overlay the shared workspace window. The user could see the drawing space and his collaborators' faces in the same space and shift easily between the two. The team explained this facility using Neisser's theory of selective looking and the high recognizability of human features, further reasoning that it is rarely necessary to attend to both at the same time (figure ground relationship), thus eliminating possible confusion of different "layers". In use, they observed that people hesitated to draw or write over people's faces, inciting them to make the face windows movable and resizable.

With ClearFace, the design team began to explore the dynamic relationship between elements in design meetings. Their focus shifted away from task - what workers are doing - to how they are relating to each other as they do it. In one of their later papers, Ishii et al. present this change as a transition from a focus on *shared workspaces* to the creation of *interpersonal spaces* (Ishii, Kobayashi and Grudin, 1992: 33).

> At the same time, in the discussion, the participants are speaking to and seeing each other, and using facial expressions and gestures to communicate. In the conversations it is essential to see the partner's face and body. The facial expressions and gestures provide a variety of non-verbal cues that are essential in human communication. The focus of a design session changes dramatically. When we discuss abstract concepts or design philosophy, we often see each other's face. When we discuss concrete system architectures, we intensively use a whiteboard by drawing diagrams on it.(Ishii and Arita, 1991:165)

The effort to simulate as closely as possible the collaboration in front of a whiteboard was taken a step further in ClearBoard, the first prototype to refer explicitly to eye contact and gaze awareness (see Figure 1). The design metaphor here was talking *through* and drawing *on* a transparent glass window. The system used colored markers on a glass board, and video and a half-mirror technique to capture and orient the drawings. In this case, users recognized their partner as being *behind* a glass board and they did not hesitate to draw over the facial image. The large size of the drawing board supported awareness of gesture and of the partner's surrounding environment, as well as of his visual focus.

> The most novel feature of ClearBoard, and the most important, is that it provides precise "gaze awareness" or "gaze tracking". A ClearBoard user can easily recognize what the partner is gazing at on the screen during a conversation. ...The importance of *eye-contact* is often discussed in the design of face-to-face communication tools. However, we believe the concept of gaze awareness is more generalized and is a more important notion. *Gaze awareness* lets a user know what the partner is looking at, the user's face or anything else on the shared workspace. If the partner is looking at you, you know it. If the partner is gazing at an object in the shared workspace, you can know what the object is. Eye contact can be seen as just a special case of *gaze awareness* (Ishii and Kobayashi, 1992: 530-531).

Figure 1. *Clearboard*

Gaze awareness allows participants to better situate the interaction within its context, providing a wider variety of cues for feedback and a richer awareness

of the environment and others' activities. The emphasis on non-verbal cues and direction of gaze rather than eye contact is particularly significant coming from a culture in which eye contact is much less common than in Western culture and is in many cases considered rude. Indeed, Ishii et al. make a veiled reference to this problem: "ClearBoard makes eye contact easy to establish and may even make it more difficult to avoid. It has been shown that the use of eye contact varies with the culture (e.g. Argyle, 1975); these are issues for further exploration in ClearBoard settings" (Ishii, Kobayashi and Grudin, 1993: 372).

Several technical problems present in ClearBoard-1 (low video resolution, forcing the use of thick markers which quickly used up the drawing space, and the inability to alter the partner's drawing in shared video drawing) were resolved in ClearBoard-2, an extension of the same idea but this time using computers. Multi-user drawing software and digitizer pens were used to permit the direct recording of work by any number of users simultaneously. This also allowed the integration of computer files into the system, and enabled the results of design sessions to be saved as PICT files. Finally, the ClearBoard-2 design led to some reflections on interpersonal distance:

> ClearBoard creates the impression of participants standing about *one meter apart*, because both sit (or stand) close enough to the screen to draw directly on its surface. This virtual distance belongs to the *personal distance* in Hall's classification. When people use ClearBoard with close friends or colleagues, this distance seems appropriate. However, for a formal meeting with a person of much higher rank, this virtual interpersonal distance might seem too small, and the participants might be uncomfortable. Therefore, we would like the media to provide users with some control over the virtual interpersonal distance. We are planning to provide an option of indirect drawing using a wireless tablet or pen-based personal computer for that purpose.(Ishii, Kobayashi and Grudin, 1993:371-372)

While the NTT Human Interface Labs team was disbanded before they were able to pursue this research direction, the concern for interpersonal distance was picked up and further explored by another research group in our next case, MAJIC.

6.2. MAJIC (MATSUSHITA LAB, KEIO UNIVERSITY)

Our second case is a system developed at the Matsushita Lab in the Instrumentation and Engineering Department of Keio University, a prestigious private university located near Tokyo. MAJIC illustrates many research themes characteristic of Japanese CSCW. To a large extent, it builds on earlier Japanese work at NTT on eye contact and gaze awareness, adding a multiparticipant dimension and a more explicit focus on the surrounding environment. This relationship to earlier work is both professional and personal. In addition to the bibliographic citations in published papers, one of the designers told me

specifically that he was influenced by Dr. Ishii's work on gaze awareness. Furthermore, one of the Clearboard designers was his *sempai* (upperclassman) at Keio University. The MAJIC team explains clearly why they feel this line of inquiry is important:

> When we have discussions in face-to-face situations and people approve of a statement, we can tell by their attitude, tone, eye movements, gestures and so forth, whether or not they approve wholeheartedly. It is difficult, on the other hand, to estimate how strongly they approve when we read only the minutes without attending a meeting. Hence, one of the purposes and/or advantages of face-to-face meetings is that all of the participants are *aware of the speaker's intent and the other listeners' reactions* based on both verbal and nonverbal communication. (Okada et al.,1994:385)

As in TeamWorkStation, there are multiple references to the importance of context, orientation to the other (how what you say is being received), and a focus on interpretation of intention rather than surface meaning. The key design issues of MAJIC were defined as (i) support of multi-way round-table meetings and multiple eye contact; (ii) maintenance of peripheral gaze awareness; (iii) seamless presentation of life-size images of participants to achieve a sense of reality; and (iv) a shared work space (Okada et al., 1994: 385).

The creation of a seamless environment and sense of presence in MAJIC relies extensively on nonverbal behavioral information, such as eye contact, gaze awareness, gesture and body language, and on contextual cues such as image size, distance and background. References to these elements are extremely specific. For example, the MAJIC team refers to symmetrical or asymmetrical postures and body orientations as important cues: "In this way we sense the atmosphere in the meeting room and the aura of the participants, and, consequently, we can understand the opinions of the participants clearly and make the meeting productive" (Okada et al., 1994: 386). They cite gaze as a means of controlling a meeting: "A chairperson sometimes gazes at participants to urge them to speak when there is silence in a meeting" (p. 386), and discuss the social uses of eye contact: "Of course eye contact is very important in communicating with one another, as mentioned above, but especially in Japan it is impolite to look into someone's eyes for a long time" (p. 387). In their observations of face-to-face meetings, the designers noted that participants most commonly averted their eyes by looking down at material on a table in front of them, and decided to provide such a table in their design (p. 390).

Referring to Hall's (1976) classifications of appropriate distances for interactions, the MAJIC team discusses elements which may affect *virtual distance* (the sensed distance among participants): physical distance from the display, the size and quality of video images, voice fidelity, backdrop, etc. In fact, this has been the central focus of most of the MAJIC research. Starting with the assumption that image size of participants and background are the two

important factors in achieving a sense of reality during videoconferencing, MAJIC I was designed to project life-size video images and to simulate a virtual social distance of approximately 4 feet between participants.

The central element of MAJIC is a large (4x8 feet), curved semi-transparent screen. Each MAJIC unit also contains a workstation (with a recessed, tilted monitor), two video projectors, two video cameras, two directional microphones and two loudspeakers. Video images of the participants are projected onto the screen and captured from behind it. Each participant sees the frontal view of the others and the edges of the images overlap slightly (see Figures 2 and 3).

The second factor deemed essential for "achieving a feeling of togetherness during videoconferencing" (p. 390) is the continuity of background images. In this interpretation of "seamlessness" if images run into each other, it is difficult to tell where one ends and the next begins; "if users are surrounded by other participants with a seamless background, they can feel as though they are together." (p. 386) In actual fact, the backgrounds must be "matched" at the seam. But this is only a prototype; MAJIC proposes doing away with the actual background altogether and replacing it with an artificial one that can be chosen to create a desired mood, to relax or to inspire (p. 386 and personal communication). This would be done using a chromakey blue background.

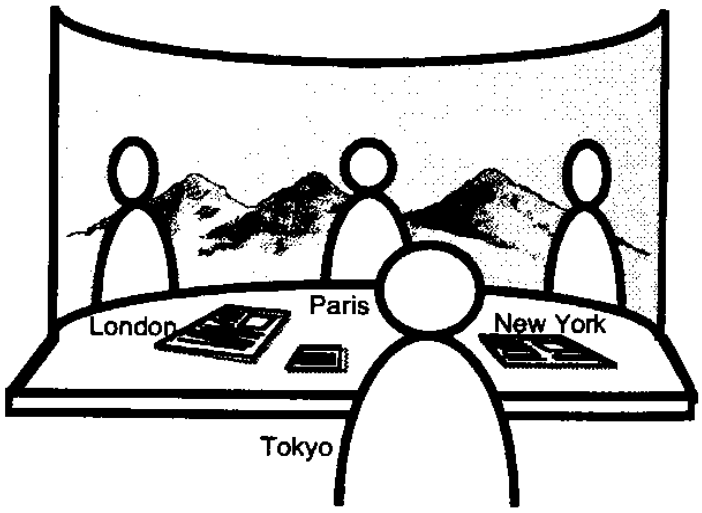

Figure 2. First draft of MAJIC

Figure 3. Gaze awareness in MAJIC, *©ACM, 1994 CSCW'94*

Laboratory evaluations of MAJIC I and observations of use at a trade fair led to several improvements or additions in MAJIC II. For example, in a questionnaire administered to 40 students, 3/4 size images were rated more convincing than life sized ones. This led to experiments to determine the ideal relationship between distance from the image and image size and an adjustment in MAJIC II. There have also been a number of strictly technical improvements: improvement of image quality, reduced size of the prototype, etc.

A further extension of the idea of direct physical manipulation in MAJIC II is the "Whisper Chair." By leaning right or left, the person sitting in this chair (equipped with sensors) can talk to one or the other persons on screen without the third party hearing. The rationale behind this development is that leaning is a more subtle, more natural way of confiding a secret than flipping a switch to turn the audio channel off.

MAJIC represents a curious mix of virtual or imaginary space and an interest in simulating reality as closely as possible, including providing direct physical feedback whenever possible. In the demonstration video of MAJIC shown at CSCW'94, the participants have a "virtual tea party" in which one person "pours" and real tea comes out into the cup of another. Although this is a presentation gimmick (and the metaphor of sharing tea is highly significant in Japanese culture), one is left wondering where the limits might be.[10]

[10] In fact, the Matsushita Lab has continued to pursue its research into the blurring of the physical and the virtual. A recent presentation at the 10th annual symposium on User Interface Software and Technology (UIST) in Banff, Alberta (October 14-17, 1997) was entitled "A virtual office environment based on a shared room realizing awareness space and transmitting awareness information."

7. Discussion

Characterizations of Japan as a society in which human relations are all-important, relationships are dependent on positioning people on vertical (hierarchy) and horizontal (in or out-group) axes, and where communication is highly indexical or context-dependent have been widely discussed in the business and sociological literature on Japan (see for example Stewart, 1987, Ito, 1989, and Barnlund, 1989 specifically on interpersonal communication in organizations). The extent of agreement in the literature suggests that they are firmly grounded in reality.

Edward T. Hall (1976), an author cited by CSCW researchers, uses the terms high- or low-context culture to refer to a culture's preferred communication style: the degree to which the meaning of a message can be abstracted from the situation in which it was produced and received. A high-context message is one in which "most of the information is either in the physical context or internalized in the person, while very little is in the coded explicit transmitted part of the message"; a low-context message is one in which "the mass of information is vested in the explicit code" (Hall, 1976: 91). The concept has implications for implicit/explicit, verbal/non-verbal, affective or intuitive/ fact-based, and relational/absolute communication. In a society like Japan where most behavior and the use of language is highly codified, the form is standard. It is important to look beneath the surface to interpret the meaning of an exchange, hence the importance of positioning and the emphasis on atmosphere. Much of the content of a message will be implicit; interpretation will often be based on intuition rather than facts; and relationships will continually shift and be redefined.

Several common traits emerge in Japanese designers' attempts to deal with the particularities of their culture. First, fully conscious of the highly relativistic approach to relationships in their society, designers do not believe that all types of communication can be supported by groupware systems. All readily admit that there are limits to supporting the more subtle or situationally dependent aspects of work. Given the constantly fluctuations and redefinitions involved in any activity which is out of the ordinary, they view the task of trying to support "delicate" communication, such as negotiation, as an impossible one. One researcher points to the impossibility of "catching" pieces of information which fly around an office and are grasped through peripheral awareness. Despite listing a shared workspace as one of the design issues and providing a workstation and table, no one has yet tried to work using MAJIC, even in the laboratory. And the NTT Software Labs team's research shifted in focus from shared workspace to interpersonal interaction during work.

A corollary of not trusting a computer system to model all instances of human communication or to successfully translate the subtleties of day to day

interaction, is the focus of many Japanese CSCW systems on providing channels for communication rather than trying to specify content or process. By providing a variety of channels, nothing more, nothing less, a CSCW system should ideally be able to support all kinds of communication regardless of the message content or objective. This is clearly the case with MAJIC in which research and evaluation have focused exclusively on the physical environment. In TeamWorkStation/Clearboard, too, the focus is on providing an environment which simulates as closely as possible a face-to-face situation and which does not in any way constrain potential use.

Another feature of Japanese CSCW systems is that they are careful to provide support for traditional, paper-based forms of working, and ways of integrating paper and electronic information. Designers view the systems they design as complementary to, not replacements for standard practices; their aim is to *support* groups, not to replace or reconfigure all their activities TWS and Clearboard use video to capture texts or drawings on paper. The MAJIC system integrates a desk that people can work on. These systems also allow people to draw using pen or pen-based computing technology. This is all the more significant considering the transformations involved in converting keyboard input to Japanese ideograms or *kanji*. As one informant notes, "typing is not easy for us."

When language cannot convey all meaning, nonverbal communication becomes more important. Perhaps most significantly, Japanese CSCW systems are also characterized by extensive emphasis on providing contextual cues so that Japanese using these systems will be able to orient their behavior appropriately. This emphasis on the contextual translates into research on spatial awareness, gaze awareness rather than eye contact, gesture, interpersonal distance, physical feedback, and large displays. One informant even went so far as to insist that physical feedback must be integrated into the interface design because he does not believe it is possible for Japanese to have an entirely intellectual relationship with the computer.

Furthermore, considerable attention is paid to creating a pleasurable physical environment or a shared environment, as in TWS or MAJIC, with tones of virtual reality. If a CSCW system is to be useful in Japan, it is important that a sense of atmosphere or feeling transpire through the system. A Japanese psychologist whose research interest is group dynamics tells me that the most important thing in Japanese groups is face-to-face communication, which creates atmosphere, or *kuuki*.[11] This is borne out by use experiments of several CSCW systems which have demonstrated that it is difficult for a group to use them without having first met to establish an atmosphere of mutual trust. "We need to meet once face to face before having such a meeting because without

[11] Maiya, personal communication 8-6-95. Maiya's interest in groupware is how *kuuki* might be transmitted at a distance.

meeting face to face we don't feel friendly or we don't feel easy to talk. ...And once we have met we can use such kind of machine. But we thought we still need video images to make the participants feel easy or feel friendly."[12]

The cases presented above illustrate the close relationship between designers' preconceptions and frames of reference and the systems they design. Japanese CSCW researchers consistently invoke Japanese culture as a justification for decisions to focus on contextual awareness and non-verbal communication in Japanese CSCW systems. The preferred Japanese approach to CSCW design is to provide a channel for communication, which can be used to complement, or supplement, traditional ways of working. This channel should transmit as much information as possible (hence the widespread use of video and large displays) but should avoid specifying procedures or ways of doing things. It is not a tool, but another element in the working environment that can offer important contextual information to enable coworkers to evaluate a situation and to respond in accordance with existing social protocols.

While certain characteristics of Japanese CSCW systems can be explained with reference to the particularities of their society, it is also significant, in our view, that there is such widespread agreement on what constitutes interesting CSCW research in Japan. Ishii's work on gaze awareness and the use of video have been picked up and pursued by the Japanese CSCW community. Similarly, the importance of gesture, body language and postures in supporting awareness between coworkers, and considerations of interpersonal distance are recurrent themes. Certainly, these issues must strike a chord as designers try to build systems that will correspond to potential uses and eventual contexts of use as they understand them.[13]

8. Implications

Clearly, the frames of meaning of Japanese CSCW researchers have a major impact on their design choices. These choices in turn guide the implementation and eventual use of these systems. Designers create artifacts to fit into cultural spaces as they understand them. New uses and new cultural meanings can only be developed after the fact. It is too early to tell whether or not CSCW designers are justified in their attention to non-verbal, contextual support. Japanese CSCW has been criticized for simply trying to simulate face-to-face reality as closely as possible and for neglecting to exploit some of the transformative potential of computer mediated communication. We would like to suggest that,

[12] Watabe, personal communication 23-6-95

[13] To some extent, Japanese researchers may also have been focusing on developing a distinctive Japanese style and building a reputation in the international community by choosing to emphasize the commonalities in their work.

rather than abdicating responsibility for the consequences of their designs, Japanese designers have adopted a pragmatic approach: designing for use as they understand it now, and leaving these uses to develop as they will.

The explicit cultural sensitivity of Japanese CSCW work also point to a need for cultural sensitivity in the *design* of technological artifacts, and at a level that goes beyond ergonomics or changing surface details on an interface. In the case of Japan, the need for contextual information suggests that the use of language-based environments, even in Japanese, may be problematic. This difficulty goes far beyond the physical difficulty of inputting on a keyboard (although this is also a definite concern, as reflected in the extensive research on pen-based computing, speech synthesis and multimodal interfaces in Japan). There appears to be a demand for virtual reality interfaces, and initial experiments have demonstrated that VR-based interfaces to applications such as internet relay chat (IRC) are indeed very popular. Secondly, the assumed difficulty of fitting into a framework, or set way of doing things, suggests that organizing cooperative work as a series of procedures to be followed or channels to be taken may be inappropriate in Japan. In fact, this is confirmed by the choice of Japan's leading workflow expert to focus on the use of resources rather than the paths they follow.

We are only beginning to appreciate the complexity of the relationship between technology and its context and how changes in one inevitably affect the other. It is important to remember that technological artifacts are being designed by *someone* and that there is nothing inevitable about how they turn out. Design choices circumscribe a field of potential uses: some are built in, others are proscribed. Consequently, it is essential to consider design in studies of the implementation and use of technology.

9. Conclusion

This paper has outlined how designers' views on Japanese culture find their way into the design rationale for CSCW systems: Japanese CSCW designers generally agree that Japan is unique and that designing for a Japanese context requires particular attention to a certain number of elements. Although it is not the only consideration in design, this attention to culture goes far beyond the stage of ideas to finds expression in the machinic reality of the computer systems, as illustrated by our two examples. The paper further proposes an explanation, grounded in the notion of cultural frame, for these observations. This explanation focuses on the interaction between the specific situation in which design is taking place, its larger social, cultural and institutional context, and the unique actions of designers. Based on how they understand the world

around them, designers make assumptions that guide their design choices.[14] As participants in their larger professional, organizational and national cultures, individual designers link their creations with larger social or cultural values. They actualize their shared understandings of Japanese culture as they perform it in their daily design activities.

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[14] Design choices are, of course, subject to constraint and enablement by situational variables which are actualized in a chain of events in the design process. How these come about would be the subject of another paper.

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